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30th Annual AMS Survey 1986

Second Report

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Second Report

A first report of the 1986 Survey appeared in the November 1986 *Notices*, pages 910–938. It included a report of the survey of faculty salaries, tenure, and women, a first report of the survey of new 1985–1986 doctorates, and a list of the names and thesis titles of the 1985–1986 doctorates included in the Survey. This second report includes an update of the fall 1986 employment status of new doctorates, an analysis of faculty mobility, and a report on fall 1986 enrollments and class sizes.

The 30th Annual AMS Survey was made under the direction of the Society's Committee on Employment and Educational Policy (CEEP), whose members in 1986 were Stefan A. Burr, Edward A. Connors, Philip C. Curtis, Jr., Gerald J. Janusz, and Donald C. Rung (chairman). A Data Subcommittee of CEEP, consisting of Lida K. Barrett, Edward A. Connors (chairman), Lincoln K. Durst, James W. Maxwell (ex officio), Donald E. McClure, and Donald C. Rung, designed the questionnaires with which the data were collected. The committee is grateful to members of the AMS staff, especially Marcia C. Almeida, for the diligence and efficiency with which the data were collected and compiled. Comments or suggestions regarding this program may be directed to the subcommittee.

Employment of New Mathematical Science Doctorates Faculty Mobility, Employment Trends, Enrollments and Departmental Size, Fall 1986

by Edward A. Connors

I. Introduction and Overview

We present patterns of employment for new doctorates in the mathematical sciences (commencing with an update of the employment status of the 1985–1986 class) and we analyze trends in the academic job market based on the 1986 AMS Survey of Faculty Mobility (30th Annual). We also provide estimates for course enrollments, majors, graduate students, and faculty in the mathematical sciences as extrapolated from the data gathered from returns of the 1986 AMS Survey on Enrollments and Departmental Size. Our extrapolation methodology is described below in the section headed "A Comment on our Extrapolation Methodology." The Mobility and Enrollments Surveys requested data for fall 1985 and fall 1986, so we have data for consecutive years from the same population. We attempt to survey all four-year college and university departments in the mathematical sciences (see below for the response rates in the various groupings). The Mobility section of the survey has three parts (Size of Faculty, Faculty Entering Department, and Faculty Leaving Department) and we use the data reported only if all three responses are useable. However, the Enrollments and Departmental Size survey form has four parts (Course Enrollments, Majors, Departmental Size, and Graduate Students) and we treat each of the parts as a separate entity as to its useability. Note that useable responses to the Mobility Survey came from 75% of Groups I–III combined, 64% of Group IV, 49% of Group M, and 37% of Group B.

Groups I and **II** include the leading departments of mathematics in the U.S. according to the 1982 assessment of Research-Doctorate Programs conducted by the Conference Board of Associated Research Councils in which departments were rated according to the quality of their graduate faculty.[1]

Group I is composed of 39 departments with scores in the 3.0 – 5.0 range.

Group II is composed of 43 departments with scores in the 2.0 – 2.9 range.

Group III contains the remaining U.S. departments reporting a doctoral program.

Group IV contains U.S. departments (or programs) of statistics, biostatistics and biometrics reporting a doctoral program.

Group V contains U.S. departments (or programs) in applied mathematics/applied science, operations research and management science which report a doctoral program.

Group Va is applied mathematics/applied science; **Group Vb** is operations research and management science.

Group VI contains doctorate-granting departments (or programs) in the mathematical sciences in Canadian universities.

Group M contains U.S. departments granting a master's degree as the highest graduate degree.

Group B contains U.S. departments granting a baccalaureate degree only.

[1] These findings were published in *An Assessment of Research-Doctorate Programs in the United States: Mathematical and Physical Sciences*, edited by Lyle V. Jones, Gardner Lindzey, and Porter E. Coggeshall, National Academy Press, Washington, D.C., 1982. The information on mathematics, statistics and computer science was presented in digest form in the April 1983 issue of *Notices*, pages 257 – 267, and an analysis of the above classifications was given in the June 1983 *Notices*, pages 392 – 393.

We regard as significant the relative increase of new women doctorates hired by the doctorate-granting institutions in Groups I-III. More specifically, 18% of all hires of new doctorates in Groups I-III were from the class of new women doctorates—this compares to 13% last year and, approximately, 10% for each of the three previous years. In fact, among all U.S. doctorate-granting institutions in the mathematical sciences (Groups I–V) new women doctorates represent 19% (40/208) of all new doctorates hired. Women doctorates comprise 17% of the new doctorates (140/801).

Useable Responses

	I	II	III	IV	V	VI	M	B
Enrollments and Departmental Size*	29	34	62	48	9	19	148	350
Faculty Mobility	29	33	54	44	9	14	129	361

*There are 4 parts to the Enrollments and Departmental Size Form (Enrollments, Majors, Departmental Size, and Graduate Students). The number given is the number of returns with a useable response on the departmental size.

Useable Responses (Percentage of Population)

	I	II	III	IV	V	VI	M	B
Enrollments and Departmental Size*	74	79	85	70	15	66	56	36
Faculty Mobility	74	77	74	64	15	48	49	37

*As Above.

New Doctorates
Fall and Spring Counts

	1982-1983	1983-1984	1984-1985	1985-1986
Fall	792	789	769	801
Spring	840	827	807	827

New Doctorates
U.S. Institutions Spring Count

1982-1983	1983-1984	1984-1985	1985-1986
796	775	765	782

New Doctorates
Awarded by Groups I–Va, VI Spring Count

1982-1983	1983-1984	1984-1985	1985-1986
767	735	755	743

Table 1A: 1985-1986 Employment Status of New Doctorates in the Mathematical Sciences

	PURE MATHEMATICS											
Type of Employer	Algebra and Number Theory	Analysis and Functional Analysis	Geometry and Topology	Logic	Probability	Statistics	Computer Science	Operations Research	Applied Mathematics	Mathematics Education	Other	Total
Group I	19	20	23	1	1	3	2	0	16	0	4	89
Group II	5	4	8	0	2	1	0	0	11	0	3	34
Group III	4	9	8	3	1	7	1	1	10	1	2	47
Group IV	0	0	0	0	4	29	0	0	0	0	3	36
Group V	0	2	0	0	1	4	1	4	6	0	1	19
Masters	10	8	9	3	0	10	2	2	14	0	4	62
Bachelors	11	16	8	8	3	5	2	2	9	0	2	66
Two-year College or High School	1	1	0	0	0	0	0	1	0	1	1	5
Other Academic Departments	1	3	1	1	2	19	2	15	12	0	11	67
Research Institutes	4	3	0	0	0	5	0	1	2	0	1	16
Government	1	0	2	1	0	9	0	3	6	0	5	27
Business and Industry	4	7	1	1	2	32	4	15	22	0	21	109
Canada, Academic	4	5	2	1	0	4	0	1	6	0	1	24
Canada, Nonacademic	1	0	1	0	0	1	0	0	2	0	0	5
Foreign, Academic	17	20	6	2	3	19	0	4	14	0	6	91
Foreign, Nonacademic	6	6	3	2	5	14	2	11	9	0	7	65
Not seeking employ.	1	1	1	0	0	5	0	0	1	0	0	9
Not yet employed	5	0	2	0	1	3	0	1	5	0	0	17
Unknown	3	2	1	0	1	1	0	1	4	0	0	13
Total	97	107	76	23	26	171	16	62	149	2	72	801

For the first time our survey asked for data on citizenship of graduate students. We requested data for fall 1985 and fall 1986 on citizenship of all graduate students and first-year graduate students, with answer options given as U.S., Canada, other, and unknown. In Groups I–III combined, U.S. citizens comprise 53% of all graduate students, and of first-year graduate students, whose citizenship was reported as known for fall 1986 (see Table 8). The raw data show an increase of U.S. citizens from fall 1985 to fall 1986 in both the first-year and total graduate student populations.

For the second consecutive year we report a decrease in total enrollments in courses taught by mathematical science departments, with a good share of the decrease resulting from a drastic decline in computer science courses. Graduate student numbers are up both for first-year and all graduate students across the board, but the number of junior-senior majors is down (see Tables 5, 6, and 7). The decline in computer science enrollments (within mathematical science departments) can be explained, we feel, by the continued creation of separate computer science departments, and the continued decline in interest in computer science careers and concentrations among entering freshmen. For example, the Higher Education Research Institute's survey of over 200,000 freshmen at 372 institutions reports that 3.5% of all surveyed reported an interest in pursuing computer careers as compared to 8.8% who so reported in 1982 (*Chronicle of Higher Education*, January 14, 1987, vol. XXXIII, no. 18, page 38).

Summing over columns of the updated employment matrix shows that of the 801 new doctorates (fall count), 171 (21%) specialized in statistics, 149 (19%) specialized in applied mathematics, 62 (8%) specialized in operations research, and 16 (2%) specialized in computer science. All told, 398 (50%) of the new doctorates are in statistics, applied mathematics, operations research, or computer science. (See Table 1B for the comparable data for the last four surveys.)

Government employment of new doctorates is nearly double that reported last year (27 compared to 14), while the total number employed by business or industry is virtually identical (109 to 108).

Part-time faculty continue their significant role in undergraduate instruction in departments in Groups M and B at roughly the same level of participation as last year. Here we have an estimated 5,270 part-time faculty (909 doctorate holding, 4,361 nondoctorate holding). In contrast, 966 part-time faculty are utilized by Groups I, II, and III combined, and approximately half of these are in Group III. If we examine the total faculty staff reported, we find that Groups B and M both report 29% part-time faculty. In contrast, Group I reports 9%, Group II reports 13%, and Group III reports 21%. We alert the reader to a forthcoming report of the MAA Committee on Teaching Assistants and Part-Time Instructors, chaired by Professor Bettye Anne Case of Florida State University, and to the CBMS 1985 Survey, chaired by Professor R. D. Anderson of Louisiana State University.

Estimates based on AMS Survey data suggest a shortfall in the number of doctorates needed for academic positions in the mathematical sciences. This shortage is most felt by the Group M and B institutions where we estimate that, of 560 new positions filled by nondoctorates, the departments would have preferred to fill 337 with doctorate-holding faculty. Of the 609 new positions filled by nondoctorate faculty in all U.S. colleges and universities (excluding Group V), the department would have preferred to fill 357 with doctorate-holding faculty.

We estimate the full-time faculty in Groups M and B combined to be 13,324 (an increase of 272 from fall 1985). Groups I–IV combined contain, we estimate, 6,719 full-time faculty (an increase of 93 over fall 1985). Tables 1A–1C provide the doctorate-nondoctorate breakdown. Thus, exclusive of Group V, we estimate the total U.S. mathematical sciences faculty to be approximately 20,000, of which approximately 15,600 hold doctorates.

Continuing the policy enunciated in the first report of the 1983 Survey, the survey no longer contains data from departments of computer science. The limited response from these departments made reliable estimates difficult. For the third year, returns from Group V departments were too small to be included. This survey, then, is an analysis of what might be called the traditional mathematics and statistics community. Because the response rate in the remaining groups continues at a high level, this year's survey gives a fairly accurate picture of faculty mobil-

Table 1B: Fields of New Doctorates*

	Year surveyed			
	1982–1983	1983–1984	1984–1985	1985–1986
Number (Full Count)	792	789	769	801
Specialty:				
Applied Math	103 (13%)	110 (14%)	115 (15%)	149 (19%)
Statistics	188 (24%)	173 (22%)	189 (25%)	171 (21%)
Operations Research	63 (8%)	66 (8%)	41 (5%)	62 (8%)
Computer Science	18 (2%)	20 (3%)	15 (2%)	16 (2%)
Total	372 (47%)	369 (47%)	360 (47%)	398 (50%)

ity, enrollments, etc., within this community. It should be noted that while departments of computer science are not included in the survey, many departments of mathematics in Groups M and B teach computer science.

II. A Comment on Our Extrapolation Methodology

The numbers in Tables 2–8 were obtained by extrapolation from the AMS Surveys and are not actual counts. The various reported totals for each group were multiplied by the ratio of the size of the faculty in that group (obtained by adjusting the comparable number given in the 1980 CBMS Report) to the number of faculty members in the responding departments, as provided on the forms submitted. We illustrate with some examples of computations and estimates from this year's survey.

We begin with our estimate of the number of full-time faculty in Groups I, II, and III combined. This number was estimated to be 5,845 in fall 1985, based on the 1980 CBMS number and adjusting yearly with AMS Survey data as follows. We received useable answers to the Faculty Mobility Survey from Groups I, II, and III, reporting 4,307 full-time faculty for fall 1985. The ratio of 5,845 to 4,307, or 1.36, is our extrapolation index for Groups I, II, and III on the mobility issues of this report. For example, they reported 131 new doctorate faculty as coming directly from graduate school, so we extrapolate to 178 (as reported

Table 2A: Faculty Flow 1985-1986 To 1986-1987

Full-Time Doctorate-Holding Faculty in 155 Doctorate-Granting Mathematics Departments in the U.S. (Groups I, II, III)

Sources of New Faculty

From	Nontenured	Tenured
Graduate school	178	
Faculty position in another U.S. or Canadian college or univ. dept.	140	39
Business, industry, or government in the U.S. or Canada	4	
Outside the U.S. or Canada	52	5
Other sources (e g., part-time in same dept.)	7	8
Total in	381	52

Faculty Leaving

	Nontenured	Tenured
To ACADEMIC employment in the U.S. or Canada in:		
Depts. granting doctorate in math. sciences	110	33
Other four-year college or university position	48	15
Two year college	4	
Other	15	7
Total Academic	177	55

Faculty Leaving (continued)

	Nontenured	Tenured
To NONACADEMIC employment in the U.S. or Canada:		
In the math. sciences, in other science, or in engineering	30	7
Other	3	4
Total Nonacademic	33	11
To OTHER:		
Currently seeking professional employment	7	
Obtained a position outside the U.S or Canada	16	3
Either retired (and do not seek employment) or have died	4	52
Returned to graduate or professional school	3	
Status unknown/other	5	3
Total Other	35	58
Total out	245	124

Received doctorate and not moving	12 (tenure status unknown)
Received tenure and not moving	110

Estimated size of full-time faculty, Fall 1986 Groups I–III

Doctorate, Tenure status unknown	12	
Doctorate, Nontenured	1281	(+26 from Fall 1985)
Doctorate, Tenured	4242	(+38 from Fall 1985)
Total Doctorate Faculty	5533	(+76 from Fall 1985)
Nondoctorate faculty	396	(+10 from Fall 1985)
Total full-time faculty	5931	(+86 from Fall 1985)

in Table 2A, Faculty Flow for Groups I, II, III). As a check we observe that the updated employment matrix (Table 1A) reports that 170 of the new doctorates were employed by Groups I, II, and III. However, our knowledge of a few institutions that did not respond to the new doctorate survey leads us to suspect that the employment matrix total would almost exactly match the extrapolated total if responses were complete.

Useable responses on the departmental size portion of the Enrollments and Departmental Size Survey report 4,695 full-time faculty in Groups I, II, and III, and hence an index of 5,845/4,695, or 1.24. However, there were 125 useable responses to the enrollments portion. Thus, we extrapolate the reported enrollment data for Groups I, II, III by multiplying the raw data reported by the product of 1.24 and 125/121. Similarly, for the majors portion of the survey (119 useable responses) and for the graduate students portion (97 useable responses).

III. Comments and Observations on the Fall 1986 Employment Status of 1985–1986 New Doctorates

Table 1A contains the fall 1986 employment status by type of employer and field of degree for 801 new mathematical sciences doctorates who received the degree between July 1, 1985, and June 30, 1986. The names of these 801 new doctorates and the titles of their doctoral theses were published in the November 1986 *Notices*, pages 924 to 938. Table 1A updates the corresponding table on page 920 of the November 1986 *Notices*, using more

Table 2B: Faculty Flow 1985-1986 To 1986-1987

Full-Time Doctorate-Holding Faculty in Group IV

Sources of New Faculty

From	Nontenured	Tenured
Graduate school	22	
Faculty position in another U.S. or Canadian college or univ. dept.	19	7
Business, industry, or government in the U.S. or Canada	5	
Outside the U.S. or Canada	2	2
Other sources (e.g., part-time in same dept.)	1	
Total in	49	9

Faculty Leaving

	Nontenured	Tenured
To ACADEMIC employment in the U.S. or Canada in:		
Depts. granting doctorate in math. sciences	14	3
Other four-year college or university position	6	
Two year college		
Other	1	
Total Academic	21	3

Faculty Leaving (continued)

	Nontenured	Tenured
To NONACADEMIC employment in the U.S. or Canada:		
In the math. sciences, in other science, or in engineering	7	2
Other	1	
Total Nonacademic	8	2
To OTHER:		
Currently seeking professional employment	1	
Obtained a position outside the U.S or Canada	6	
Either retired (and do not seek employment) or have died	0	9
Returned to graduate or professional school	0	
Status unknown/other	0	
Total Other	7	9
Total out	36	14

Received doctorate and not moving	1
Received tenure and not moving	20

Estimated size of full-time faculty, Fall 1986 Group IV

Doctorate, Tenure status unknown	1	
Doctorate, Nontenured	240	(– 7 from Fall 1985)
Doctorate, Tenured	528	(+15 from Fall 1985)
Total Doctorate Faculty	769	
Nondoctorate faculty	19	(– 2 from Fall 1985)
Total full-time faculty	788	(+ 7 from Fall 1985)

recent information provided by departments and the recipients of the degrees. Note that 801 is the fall count for 1985–1986 and does not include the additional recipients who were reported too late to gather employment information for these reports, but who are included in the spring count for 1985–1986. (A supplementary list of recipients appears in this issue of *Notices*.)

The first five rows in Table 1A refer to those 1985–1986 new doctorates employed by doctorate-granting departments in the U.S. The next two rows refer to those employed by U.S. mathematical sciences departments which grant master's and bachelor's degrees as the highest degree, respectively. The remaining row designations are self-explanatory.

Academic Employment

There was an increase over last year in the hiring of new doctorates by U.S. doctorate-granting departments (225 versus 206) with a marked increase in Group IV (36 versus 19). The decline in hiring of new doctorates by Group III (47, down from 59) is tempered by the realization that only 39 were hired two years ago. Note that these comparisons are derived from the updated employment matrices which appear annually in the February or March issue of these *Notices*. Fewer new doctorates were hired by Groups M and B than last year (128 versus 138) but approximately 337 positions that M and B departments intended for doctorate holders were filled by nondoctorate faculty. It seems that job prospects for new

Table 2C: Faculty Flow 1985-1986 To 1986-1987

Full-Time Mathematical Sciences Faculty in Groups M and B

Sources of New Faculty

From	Doctorate	Nondoctorate
Graduate school	151	236
Faculty position in another U.S. or Canadian college or univ. dept.	394	126
Business, industry, or government in the U.S. or Canada	47	57
Outside the U.S. or Canada	35	5
Other sources (e.g., part-time in same dept.)	62	136
Total in	689	560

Faculty Leaving

	Doctorate	Nondoctorate
To ACADEMIC employment in the U.S. or Canada in:		
Depts. granting doctorate in math. sciences	50	12
Other four-year college or university position	173	109
Two year college	7	15
Other	17	62
Total Academic	247	198

Faculty Leaving (continued)

	Doctorate	Nondoctorate
To NONACADEMIC employment in the U.S. or Canada:		
In the math. sciences, in other science, or in engineering	47	69
Other	10	10
Total Nonacademic	57	79
To OTHER:		
Currently seeking professional employment	17	30
Obtained a position outside the U.S or Canada	10	7
Either retired (and do not seek employment) or have died	67	102
Returned to graduate or professional school	7	69
Status unknown/other	32	55
Total Other	133	263
Total out	437	540

Received doctorate and not moving	99
Received tenure and not moving	
Doctorate	270
Nondoctorate	47

Estimated size of full-time faculty, Fall 1986 Groups M and B

Doctorate holding	9295	(+351 from Fall 1985)
Nondoctorate faculty	4029	(− 79 from Fall 1985)
Total full-time faculty*	13324	(+272 from Fall 1985)

* Last year's total of 13,052 is reported correctly in the table, but it is misprinted as 13,502 in the text on p. 293.

doctorates in the mathematical sciences are very good in Groups M and B, especially if academic and teaching strengths are complemented by an ability to teach statistics and computer science.

As reported earlier, new women doctorates comprise 18% of the new doctorates employed by Groups I–III (compared to only 13% last year and 10% each of the three previous years). Among all U. S. doctorate-granting institutions (departments or programs) 19% of new mathematical science doctorates were women. Although the percentage of women among all new doctorates is 17%, we caution that the apparent gain is relative only—only 140 of 801 new doctorates were awarded to women. In Groups I–IV, M, and B, the percentage of new women doctoratees to all new doctorates hired is: Group I (13%), Group II (26%), Group III (21%), Group IV (25%), Group M (19%), and Group B (21%).

The number of new doctorates accepting Canadian academic positions increased slightly over last year (24 versus 22), whereas the number accepting foreign, non-Canadian academic positions decreased (91 from 96).

Faculty Mobility

This part of the Annual Survey is concerned with the numbers and sources of newly hired faculty and the employment status of the recently departed. We monitor trends in tenure and doctorate recipients. The response to the 1986 Faculty Mobility Survey was considerably larger than last year and larger than two years ago. The responding departments account for more than half (52%) of all mathematical sciences faculty members. Roughly 75% of the faculty in the doctorate-granting mathematics departments (Groups I–III) are represented in the responses. The relevant tables are 2A, 2B, and 2C.

Tables 2A, 2B, and 2C show estimated faculty flow between 1985–1986 and 1986–1987 for U. S. departments. A composite number for all U. S. departments, excluding Group V, may be obtained by adding corresponding rows. The left side of each table shows the estimated numbers of new full-time faculty members hired from the sources indicated between fall 1985 and fall 1986. The right side of each table shows the fall 1986 employment status of those full-time faculty members (as of fall 1985) who had permanently left their departments by fall 1986.

Combining Tables 2A, 2B, and 2C, we show an estimated increase of 423 in the size of the doctorate-holding faculty and a decrease of 71 in the nondoctorate faculty, for an overall increase of 352. Last year's net increase was 469 and the previous year's was 681. We estimate that of 606 positions filled by nondoctorates in Groups III, M, and B, doctorate-holding faculty were preferred for 355. Thus we have a pattern of replacement and/or utilization of nondoctorate faculty in lieu of doctorate-holding faculty among the vast majority of our mathematical sciences departments.

Attrition because of death and retirement was 1.2%, down from last year's 1.4% but equal to the previous year. Retirements and deaths seem to hover near 1%.

Nonacademic Employment

Table 3 presents a summary of AMS Survey data on nonacademic employment in the U. S. of new doctorates from 1979–1980 to 1985–1986. Note that the percentage of new doctorates in government/business/industry had held constant at 22% (of all new doctorates) for three years, but jumped to 24% on the strength of increased government hiring. This year 27 new doctorates

Table 3: New Mathematical Sciences Doctorates Taking Nonacademic Positions in U.S.

	1979 -80	1980 -81	1981 -82	1982 -83	1983 -84	1984 -85	1985 -86
In government	37	28	22	24	23	14	27
In business/ industry	165	169	141	105	110	108	109
Total	202	197	163	129	133	122	136
Total new doctorates employed in U.S.	691	732	659	583	597	557	577
% in govt./ bus./ind.	29%	27%	25%	22%	22%	22%	24%

Table 4: Estimated Net Outflow of Doctorate-Holding Faculty Members to Nonacademic Employment

	1979 -80	1980 -81	1981 -82	1982 -83	1983 -84	1984 -85	1985 -86
Net outflow	168	116	94	46	125	22	55

took employment with government compared to 14 last year.

Table 4 presents the estimated annual net outflow of doctorate-holding faculty to nonacademic positions since 1979. The number 55 is obtained from Tables 2A, 2B, and 2C, with the breakdown as follows. Groups I, II, III combined (net outflow of 40); Group IV (net outflow of 5); Groups M and B (net outflow of 10). The net outflow is much more than twice that of a year ago but less than half of two years ago.

Enrollments

Undergraduate enrollments declined for the second straight year but a considerable portion of the decline is tied to the shift in computer science courses taught in mathematics departments. Several of the computer science courses previously taught in mathematics departments are now being taught in rather recently created computer science departments. At the same time, there is a precipitous decline in interest in computer science as a major, especially among freshmen (see the *Chronicle* article cited earlier). There is an increase in graduate enrollments and another increase in "courses below calculus" (excluding computer science and statistics). The increase in these so-called "precalculus" and, often, remedial courses is most felt in Group B (+3%). It does seem, however, that the hitherto rapid rate of increase of precalculus and remedial courses has lessened somewhat.

IV. Summary

In summary, we report an increase over last year in the number of new doctorates in the mathematical sciences—the first such increase in several years. The percentage and absolute number of U.S. citizens among the doctoral recipients from U.S. institutions continued to decline (see the First Report of the 30th Annual AMS Survey in the November 1986 *Notices*, pages 922–923). The percentage of women among the new doctorates (including Canadian degrees) is 17% (fall count—used for consistency in comparison utilizing updated employed matrix, Table 1A). The percentage of women among the new doctorates hired by U.S. doctorate-granting institutions is 19%. The percentage of women among the new doctorates hired by Groups M and B is 20%. A significant percentage (60%) of nondoctorate faculty were hired in Groups M and B for positions for which the department indicated a preference for a doctorate holder. We project that 337 positions were so filled. In U.S. doctorate-granting departments U.S. citizens account for approximately 53% of the graduate students whose citizenship is reported as known. In Groups I, II, and III, the number of U.S. citizens among first-year graduate students is up by 6% over last year (reporting institutions are the same for fall 1985 and fall 1986) Fifty percent of the new doctorates are in the fields of statistics (21%), applied mathematics (19%), operations research (8%), or computer science (2%). We note that the percentages and the absolute numbers in applied mathematics itself are substantially up from our surveys in the early 1980s. Overall course enrollments are down slightly, but a good part of the decline is because of decreased teaching of computer science courses in mathematics departments. In Groups M and B enrollments in remedial and/or "precalculus" courses increased over fall 1985 but the rate of increase is not as great as it has been in recent years. Graduate enrollments are up in all groups and undergraduate enrollments in statistics rose by 2% in Group M.

Table 5: Total Course Enrollments for Fall 1986 (in Thousands)

(Percent increase from fall 1985 in parentheses)*

Type of Course	Groups							
	I, II, III		IV		VI		M, B	
Below calculus	285	(0%)			10	(+1%)	637	(+2%)
First year calculus	214	(−4%)			43	(+3%)	232	(−4%)
Statistics	26	(−2%)	52	(−3%)	28	(+8%)	109	(+1%)
Computer Science	13	(−27%)			4	(−10%)	174	(−11%)
Other undergraduate mathematics courses	172	(−3%)			45	(−4%)	203	(−3%)
Total Undergraduate	710	(−3%)			130	(+1%)	1355	(−2%)
Graduate courses	27	(+1%)	14	(+11%)	1	(+29%)	21	(+9%)
All courses	737	(−3%)	66	(0%)	131	(+1%)	1376	(−3%)

*This percentage is obtained from the raw data as reported for the two years on this 30th Annual Survey. It is not based on last year's estimates.

Table 6: Majors

(Percent increase over fall 1985 in parentheses)*

Fall 1986

	I, II, III	IV	VI	M, B
Total junior-senior majors	19215 (−2%)	1060 (+13%)	5660 (+7%)	62797 (−2%)

*See footnote for Table 5.

Table 7: Graduate Students

(Percent increase over fall 1985 in parentheses)

Fall 1986

	I, II, III	IV	VI	M + B
First Year	2959 (+6%)	653 (+12%)	246 (+1%)	1261 (+9%)
All	9013 (+6%)	1925 (+5%)	700 (+16%)	3265 (+1%)

Table 8: Citizenship of Graduate Students

(Percentage of U.S. citizens of graduate students whose citizenship is reported as known)

	Fall 1985		Fall 1986	
Group	First Year	All Years	First Year	All Years
I	55	54	54	54
II	53	55	54	53
III	52	54	52	51
I,II,III	53	54	53	53
IV	56	53	59	53
M	72	63	66	69

Table 9: Average Class Size Fall 1986

(Fall 1985 size as also reported in this year's survey is in parentheses)

	Groups											
Type of Course	I		II		III		IV		M		B	
Below calculus (excluding statistics and computer science)	35	(36)	41	(42)	49	(47)	—	—	38	(38)	30	(30)
First year calculus	36	(37)	44	(44)	41	(41)	—	—	32	(33)	26	(26)
Undergraduate statistics	30	(31)	27	(27)	37	(39)	42	(43)	33	(34)	27	(27)
Undergraduate computer science	32	(36)	27	(27)	28	(31)	—	—	24	(25)	20	(21)
Other Undergraduate mathematics	30	(31)	32	(33)	32	(32)	—	—	24	(25)	17	(17)
All graduate	10	(10)	11	(11)	10	(10)	16	(15)	10	(11)		
Total	30	(32)	36	(36)	37	(37)	32	(32)	30	(31)	24	(25)

Doctoral Degrees Conferred in 1985–1986 (Supplementary List)

The following list supplements the list of thesis titles published in the November 1986 issue of *Notices* (see page 924 for an explanation of the numbers in parentheses).

ARIZONA

University of Arizona
(8;2,0,0,0,6,0,0)

APPLIED MATHEMATICS

Clough, Anne, *A mathematical model of single photon emission computed tomography.*

Dagan, Arie, *Some aspects of vortex line reconnection.*

Hammel, Steven, *A dissipative map of the plane—a model for optical bistability.*

Shelley, Michael, *The application of boundary integral techniques to multiply connected domains.*

Tonellato, Peter, *Critical behavior of an ignition model in chemical combustion.*

Weyker, Robert, *Resonance and asymptotic series based identification of an acoustically rigid sphere.*

MATHEMATICS

Sade, Martin, *Variational principles for field variables subject to group actions.*

Wang, Kwang-Shang, *Finite groups for which every complex representation is realizable.*

ILLINOIS

University of Chicago
(3;2,0,0,0,1,0,0)

MATHEMATICS

Crane, Louis, *Action of the loop group on the self-dual Yang-Mills equation.*

Harris, John, *Stable splittings of classifying spaces.*

Squeff, Christina, *Super-convergence of mixed finite element methods for parabolic equations.*

NEW YORK

CUNY, Graduate Center
(2;1,0,0,0,1,0,0)

MATHEMATICS

Benardete, Diego, *Topological equivalence of flows on homogeneous spaces, divergence of subgroups, and asymptotic homotopy classes.*

Kim, Myong-Hi, *Complexity of Newton-Euler type algorithms.*

PENNSYLVANIA

Carnegie-Mellon University
(4;1,0,0,0,2,0,1)

MATHEMATICS

Chang, Ching Lung, *Finite element approximations for first order linear elliptic systems.*

Hodgdon, Marion Louise, *Solutions of the Field relations in a theory of shear bands.*

Strojwas, Malina, *Tangential approximations.*

Turner, James Clarence, *A finite element analysis of a zero equation model of turbulence.*

Lehigh University
(2;1,0,0,0,0,0,1)

MATHEMATICS

Bailey, Carmine Michael, *On the optimum design of piston rings.*

Schaffer, Matthew John, *Permanence and universal family theorems for conuli FK spaces.*

SOUTH CAROLINA

Clemson University
(7;1,1,1,0,1,0,3)

MATHEMATICAL SCIENCES

Chien, Victor, *Parameter estimation for a diffusion problem in a semi-infinite interval.*

Kovalcik, William, *A lumped parameter model of evaporation-condensation driven convective flows in atmospheric environments.*

Padua, Roberto, *Some robust estimates of the regression coefficients.*

Peters, Kenneth, *Theoretical and algorithmic results on domination and connectivity.*

Piazza, Barry, *Hamiltonian and connectivity properties of permutation graphs.*

Portier, Frederick J., *An integrated approach to discrete simulation: Theory, methodology, and computer aided program generation.*

Stueckle, Samuel, *Algebraic and isomorphism properties of permutation graphs.*